



NASA Langley's Electrostrictive Polymers

Enable sensing and actuation devices

Scientists at NASA's Langley Research Center have developed a family of electrostrictive polymeric materials that are available for use by commercial companies. These innovative materials provide significant field-induced strain, high mechanical output force, and exceptional strain energy density. The NASA-developed electrostrictive polymers are conformable, lightweight, and durable. The processing system to fabricate these polymers is simple and can be manipulated to control and optimize the materials' mechanical and electrical properties.

Benefits

- Significant field-induced strain – large motion per voltage
- Low energy consumption
- Lightweight and durable
- Conformable and flexible
- Simple processing
- Adjustable process to optimize electrical and mechanical properties

partnership opportunity



Applications

The technology offers wide-ranging market applications, including:

- Space structures – Enable control of membrane structures used in space structures for shaping, tuning, and positioning for reflectors, antennas, solar arrays and sails, or optical mirrors. A control system based on the subject technology could be folded and packaged with the membrane structure prior to deployment.
- Military – Enable submarine sound signature variation by manipulating skin friction characteristics.
- Transportation – Aircraft for changing air flow on structures, automobile sensors including accelerometers, ships for drag reduction and associated fuel savings
- Biomedical applications
- Microrobotics

The Technology

A variety of elastomers can be used for this technology, which enables grafting with materials like PVDF to provide electrostrictive behavior. NASA has invested in research related to these materials, the processing, and applications including sensing and actuation. The process can be tailored by:

- Molecular synthesis – selection of the appropriate polymer backbone and graft polar base
- Variation of the fraction of the two constituent polymers
- Variation of the molecular weight of the two constituent polymers
- Electroprocessing (poling)
- Thermal treatment
- Mechanical treatment

NASA's Innovative Materials Compared to Existing Market Technologies

Material	Strain (%)	Modulus (Mpa)	Output Force (Mpa)	Strain Energy Density (J/kg)
NASA Electrostrictive Polymer	4	580	23.2	267
Polyurethanes	4	20	0.8	13
PVDF	0.3	1,600	4.8	4
PZT	0.3	64,000	192	38

Related Patents

Bi-layer actuator – 6,545,391

Material and processing – 6,515,077

Shaping, tuning, positioning of membranes – 7,015,624; 6,724,130; 6,867,533 respectively

Sensing/actuation—6,689,288

For More Information

If your company is interested in licensing or joint development opportunities associated with this technology, or if you would like additional information on partnering with NASA, please contact:

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LAR-15960-1, LAR-16038-1, LAR-16039-1, LAR-16219-1,
LAR-16220-1, LAR-16232-1-NP

